

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY



(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference 37683 PC 01 | | FOR FURTHER ACTION | | See Form PCT/PEA/416 |
| International application No. PCT/DK2004/000680 | | International filing date (day/month/year) 08.10.2004 | | Priority date (day/month/year) 24.11.2003 |
| International Patent Classification (IPC) or national classification and IPC H04R1/04, H03M3/04, H04R3/00 | | | | |
| Applicant SONION AS ET AL. | | | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 10 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 3 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | | | |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input checked="" type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p> | | | | |
| Date of submission of the demand 26.08.2005 | | Date of completion of this report 06.02.2006 | | |
| Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | | Authorized Officer Moscu, V Telephone No. +31 70 340-2034  | | |

**INTERNATIONAL PRELIMINARY REPORT
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International application No.
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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-11 as originally filed

Claims, Numbers

1-18 received on 29.08.2005 with letter of 26.08.2005

Drawings, Sheets

1-5 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:
- ☐ the entire international application,
 - ☒ claims Nos. 11
because:
 - ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):
 - ☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):
 - ☒ the claims, or said claims Nos. 11 are so inadequately supported by the description that no meaningful opinion could be formed.
 - ☐ no international search report has been established for the said claims Nos.
 - ☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:
 - the written form ☐ has not been furnished
 - ☐ does not comply with the standard
 - the computer readable form ☐ has not been furnished
 - ☐ does not comply with the standard
 - ☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.
 - ☒ See separate sheet for further details

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------------------|
| Novelty (N) | Yes: Claims | 3-10,13,14,16,18 |
| | No: Claims | 1,2,12,15,17 |
| Inventive step (IS) | Yes: Claims | |
| | No: Claims | 1-10,12-18 |
| Industrial applicability (IA) | Yes: Claims | 1-10,12-18 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

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Re Item III.

1. The feature of claim 11, namely that the digital signal converter comprises a delay circuit in cascade with an integer ratio upsampler, is not referred to in the description. Claim 11 is therefore not supported by the description as required by Article 6 PCT.

Re Item V.

1. The following documents are referred to in this communication:

D1: US-A-5 051 799 (PAUL ET AL) 24 September 1991 (1991-09-24)
D2: WO 03/023970 A (MICROSEMI CORPORATION) 20 March 2003 (2003-03-20)
D3: WO 03/088709 A (SONION A/S; DERUGINSKY, MICHAEL; POULSEN, JENS,
KRISTIAN; BOSCH, JOZEF) 23 October 2003 (2003-10-23)
D4: US-B1-6 326 912 (FUJIMORI ICHIRO) 4 December 2001 (2001-12-04)

2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1, 2, 12, 15 and 17 is not new in the sense of Article 33(2) PCT.

- 2.1. The document D1 discloses (the references in parentheses applying to this document):

A digital microphone (Col. 1 Lines 6-10; Fig. 1) comprising:

a microphone housing (implicit) having a sound inlet (implicit) and comprising:

- a transducer element (Fig. 2 Ref. 100) comprising a displaceable diaphragm (implicit) and adapted to generate a transducer signal representative of sound received through the sound inlet (implicit),
- an analog-to-digital converter (Fig. 2 Ref. 108) comprising a multi-level quantizer (Col. 4 Lines 41-54; implicit) operatively coupled to the transducer means (Fig. 2 Ref. 100) to convert the transducer signal (Fig. 2 Ref. 102) into multi-bit samples (Col. 4 Lines 41-54) representative of the transducer signal,
- a digital signal converter (Fig. 2 Ref. 200, 114) adapted to convert the multi-bit samples into a single-bit output signal (Col. 6 Line 64 - Col. 7 Line 26), and
- an externally accessible terminal (implicit) adapted to provide the single bit output signal (Col. 6 Line 64 - Col. 7 Line 26).

The Examining Authority is considering that the single transmission path (eg. cable) disclosed in D1 (Col. 6 Line 64 - Col. 7 Line 26), is transmitting the data in form of a single-bit output signal and has the same technical functionality as the apparatus for which

protection is to be sought by claim 1. The subject-matter of claim 1 is therefore not new (Article 33(1) and (2) PCT).

2.2 The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claim 15 which therefore is also considered not new.

2.3 In addition to the subject-matter of independent claim 1 the apparatus disclosed in D1 (the references in parentheses applying to this document) is characterised by the followings:

The analog-to-digital converter (Fig. 1, Ref. 108) comprises an oversampled delta-sigma modulator (Col. 4, Lines 41-54).

A preamplifier (Fig. 1, Ref. 104) is interposed between the transducer element (Fig. 1, Ref. 100) and the analog-to-digital converter (Fig. 1, Ref. 108).

The subject-matter of claims 2 and 12 is therefore not new (Article 33(1) and (2) PCT).

2.4 In addition to the subject-matter of independent claim 15, D1 discloses that the analog-to-digital converter comprises an oversampled delta-sigma modulator (Col. 4 Lines 41-54).

The subject-matter of claim 17 is therefore not new (Article 33(1) and (2) PCT).

3. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 3-10, 13, 14, 16 and 18 does not involve an inventive step in the sense of Article 33(3) PCT.

3.1 The additional features of claims 3-5 regarding the clock signal does not involve an inventive step since all digital devices need a clock signal which is either generated internal or received from an external source. In addition a DC voltage supply extracted from an external clock signal is well known into the art e.g. D3 (Pag. 4 Lines 25-31).

3.2 The additional features of claim 13 regarding an interpolator operatively coupled between the multi-bit samples provided by the analog-to-digital converter and the digital signal converter is well known into the art e.g. D4 (Col. 4, Line 61 - Col. 5, Line 10).

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- 3.3 The subject-matter of dependent claims 6-10, 14, 16 and 18 does not involve an inventive step over the disclosure of D1 or D2, because the additional features over the independent claims 1 or 15 respectively, represent normal design choices extensively used, by the case, in analog to digital converters, digital devices or portable communication devices comprising digital microphones.

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Re Item VII.

- 1.1 To meet the requirements of Rule 5.1(a)(ii) PCT, the documents D1 and D2 should be identified in the description and the relevant background art disclosed therein should be briefly discussed.
- 1.2 Independent claims 1 and 15 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
- 1.3 Multiple dependent claims shall not serve as a basis for any other multiple dependent claim (Rule 6.4(a) PCT).

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Re Item VIII.

- 1 The feature of claim 11, namely that the digital signal converter comprises a delay circuit in cascade with an integer ratio upsampler, is not referred to in the description. Claim 11 is therefore not supported by the description as required by Article 6 PCT.

NEW CLAIMS (August, 2005)

1. A digital microphone comprising:

5 a microphone housing (2) having a sound inlet (3) and comprising:

- a transducer element (1) comprising a displaceable diaphragm and adapted to generate a transducer signal representative of sound received through the sound inlet (3),

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- an analog-to-digital converter (40) comprising a multi-level quantizer operatively coupled to the transducer means to convert the transducer signal into multi-bit samples representative of the transducer signal,

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- a digital signal converter (50) adapted to convert the multi-bit samples into a single-bit output signal, and

- an externally accessible terminal (60) adapted to provide the single-bit output signal.

20 2. A digital microphone according to claim 1, wherein the analog-to-digital converter (40) comprises an oversampled delta-sigma modulator.

3. A digital microphone according to claim 1 or 2, comprising an integral clock generator operatively coupled to the analog-to-digital converter (40) and the digital signal converter (50).
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4. A digital microphone according to any of claims 1- 3, wherein the microphone housing (2) comprises a second externally accessible terminal (61) for receipt of an external clock signal.

5. A digital microphone according to claim 4, comprising DC voltage generating means disposed within the microphone housing (2) and operatively coupled to the external clock signal so as to derive a DC voltage supply for operating at least the analog-to-digital converter (40).
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6. A digital microphone according to any of the preceding claims, wherein the multi-level quantizer (45) of the analog-to-digital converter (40) comprises between 3 and 64 discrete quantization levels.
- 5 7. A digital microphone according to any of the preceding claims, wherein the multi-bit samples provided by the analog-to-digital converter (40) are represented in two's complement format.
8. A digital microphone according to any of the preceding claims, wherein multi-bit
- 10 samples generated by the multi-level quantizer (45) are represented by a set of corresponding symbols, and
- wherein each symbol comprises a number of one signs which is proportional with a magnitude of the corresponding multi-bit sample.
- 15 9. A digital microphone according to claim 8, wherein the multi-level quantizer (45) comprises 3 or 5 discrete quantization levels.
10. A digital microphone according to claim 8, wherein the multi-level quantizer (45) comprises N discrete quantization levels and each corresponding symbol comprises N-1
- 20 bits;
- N being an integer between 3 and 17.
11. A digital microphone according to any of claims 8-10, wherein the digital signal converter (50) comprises a delay circuit in cascade with an integer ratio upsampler.
- 25 12. A digital microphone according to any of the preceding claims, comprising a preamplifier (20) interposed between the transducer element (1) and the analog-to-digital converter (40).
- 30 13. A digital microphone according to any of the preceding claims, comprising an interpolator (55) operatively coupled between the multi-bit samples provided by the analog-to-digital converter (40) and the digital signal converter (50).
14. A portable communication device comprising a digital microphone according to any of
- 35 the preceding claims.

15. A monolithic integrated circuit for a miniature microphone, comprising
- a preamplifier (20) adapted to provide an amplified transducer signal and comprising
5 an input section couplable to a miniature electret or condenser transducer element (1),
 - an analog-to-digital converter (40) comprising a multilevel-quantizer (45) operatively
coupled to the amplified transducer signal and adapted to convert the amplified
transducer signal into multi-bit samples representative of the amplified transducer
10 signal,
 - a digital signal converter (50) adapted to convert the multi-bit samples into a single-bit
output signal, and
 - 15 - an integrated circuit pad adapted to provide the single-bit output signal.
16. A monolithic integrated circuit according to claim 15, wherein multi-bit samples
generated by the multi-level quantizer (45) are represented by a set of corresponding
symbols, and
- 20 - wherein each symbol comprises a number of one signs which is proportional with a
magnitude of the corresponding multi-bit sample.
17. A digital microphone according to claim 15 or 16, wherein the analog-to-digital
converter (40) comprises an oversampled delta-sigma modulator.
- 25
18. A monolithic integrated circuit according to any of claims 15 - 17, wherein the multi-
level quantizer (45) of the analog-to-digital converter (40) comprises 3 or 5 discrete
quantization levels.